Model Testing, Analysis, and Evaluation and Data Needs

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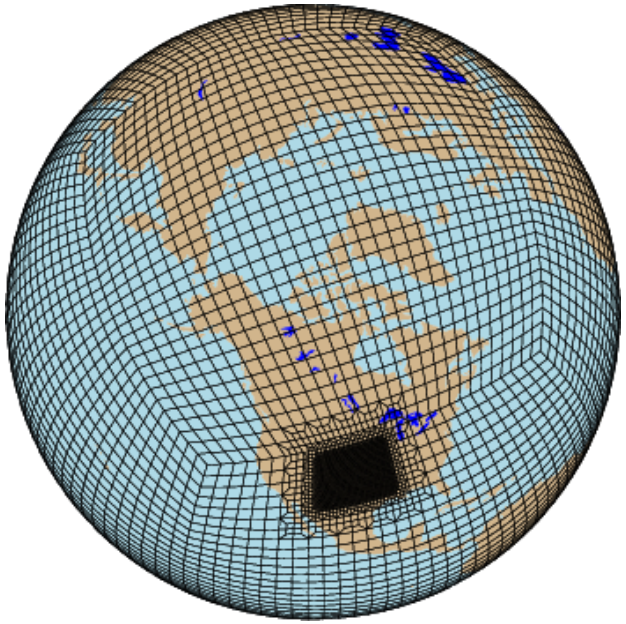

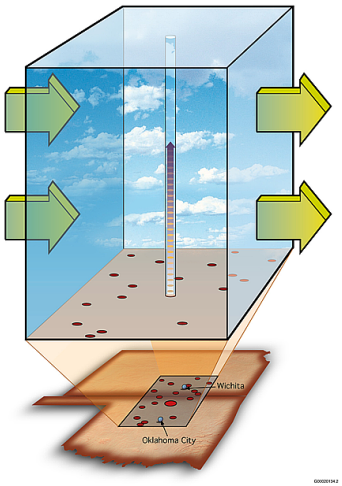

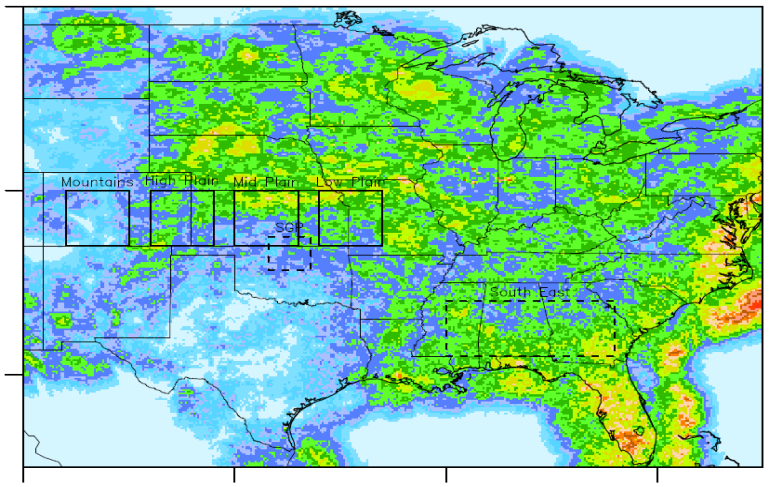

Modeling Challenges

- Simultaneously modeling the multi-scale characteristics of the water cycle (sub-km to global) in the context of imperfect models
- How to successfully couple models of human dimensions with physical system models

Issues

- Identifying the sources and causes of errors within component models or once component models have been coupled
- Potential for compensating errors in complex systems is large
- How does one evaluate the fidelity and uncertainties in human system models (which tend to not be as physically based)?

Issues

- Developing modeling frameworks that can isolate errors in different modeling components and scales to build confidence is key
- Hypothesis-driven testing is necessary
- Articulating what questions we want a model to address is important

Techniques

- Model intercomparison exercises nicely document the range of model behaviors, but are not effective at understanding the reasons for those behaviors
- Detailed analysis of model behaviors and processes often in the context of a single model with perturbations ('testbeds') can be more insightful
- We are currently unaware of a model test-bed that simulates both the multi-scale nature of the water cycle and includes human earth system models
  - A few km atmosphere-land models over a limited area driven by (or embedded within) a larger-scale model might be a starting point (other examples exist)

Diagnostics & Metrics

- A basket of metrics is needed to reduce the potential for compensating errors
- Diagnostics of model processes are needed to determine the physical reasons that a model produces a given result and to build understanding

Observations

- It is difficult to observe the components of and thus close the water budget over any relevant scales
  - Precipitation
  - Evaporation
  - Horizontal transports of water in the atmosphere or land
- Observations/data of human-system impacts on the water cycles is needed
- Quantified observational uncertainties are needed
- We need to better define what we need from observations

Priorities

- Needs should stem of a prioritized list of specific questions that we want models to address
- Demonstrate credibility by modeling past events
  - Develop a coupled multi-scale model of the water cycle with human components
  - Simulate extreme events of the regional-scale hydrologic cycle (e.g., over USA)
  - The feedbacks from the small- and regional- scales and from human choices on the large-scale water cycle are excluded, but we felt it was necessary to start somewhere to develop credibility in model components

Priorities

- We need a greater number of improved simultaneous observations of the water cycle at multiple scales and data of the human dimension (e.g., water management)

Lunchtime Speakers

- Kevin Trenberth – Data needs for the evaluation of the multi-scale aspects of the water cycle
- Randy Koster – Gaps and limitations in land-surface modeling
- Kate Calvin – Model testing and evaluation for human systems and/or integrated assessment models
- Minghua Zhang – Gaps and limitations in atmospheric modeling of the water cycle